INDIANAPOLIS MOTOR SPEEDWAY®

INDIANAPOLIS 500®

THE SIMULATION™

ELECTRONIC ARTS®

INDIANAPOLIS 500® THE SIMULATION™

RACING BY THE RULES

You've just spent three years and your life savings designing the hottest racing machine on four wheels. You're looking forward to making and selling lots of them — not just for profit but to make enough money so you can start over and design an even better car. But as soon as you start selling your cars, you learn that somebody already took one apart, quickly drew up some blueprints, and is giving away your secrets so others can build your awesome car by themselves. In response, you have to raise the price of your cars to make up for the people who are getting them free.

Patents make the above scenario illegal. The story is the same with software, except it's a Copyright that makes copying software without permission a violation of federal law. And when you copy Indianapolis 500 illegally, you raise the cost to the people who legally buy the software. Indianapolis 500 was produced through the efforts of many people: designers, artists, programmers, and other dedicated workers, who need the money from selling software to create more software.

ELECTRONIC ARTS is a member of the Software Publishers Association (SPA) and supports the industry's effort to fight the illegal copying of personal computer software. Thank you for helping us fight to eliminate software theft so we can control software costs.

WELCOME

With better than three-quarters of a century of racing behind us, we at the Indianapolis Motor Speedway welcome you to the Indianapolis 500-mile classic.

We have an impressive roster of new hopefuls competing to qualify for this year's race, and we're confident that the top 33 racers will make this the most exciting race yet.

Let us now take you through the process of entering, competing in, and possibly winning, the Indianapolis 500 — all of which takes place in the month of May.

THE TRACK

Built in 1909, the Indianapolis Motor Speedway was originally covered with crushed stone and tar, but a few races made it clear that a better surface was needed. Red bricks — enough to fill 500 railroad cars — were brought in to cover the track. The track was paved with asphalt starting in 1937, and in 1962 the entire track and pit area was resurfaced. One yard of bricks remains at the start/finish line as a reminder of the original construction that gave the speedway its nickname, "The Brickyard."

Track Statistics	
Length (miles)	
Total	$2\,^1/_2$
Long straights	$^5/_8$
Short straights	$^1/_8$
Corners	$^1/_4$
Widths (feet)	
Straights	50
Corners	60
Banked Turns	9° 12"
Surface	Asphalt

QUIZ QUESTION 1. Who was the only third generation driver to race at Indy?

THE MONTH OF MAY

On the first weekend of May, the Indianapolis Motor Speedway opens for rookie testing and practice. The second weekend marks the first qualifying attempts. Drivers practice and help their crews modify their cars until the third weekend, when the final qualifying sessions are held. During the fourth week, the teams convert their cars from qualifying to racing configuration. Finally, Race Day is the Sunday of Memorial Day weekend.

Weekend 1: Practice

Familiarizing yourself with the track is the first crucial step to mastering the speedway. First choose your car: a March/Cosworth, a Lola/Buick, or a Penske/Chevrolet. The cars have different handling characteristics, but those differences alone won't affect the outcome of the race. The overall performance of each machine depends on a complex combination of driver skills and car setup.

Learn to drive the car down the straights. Stay close to the right wall on the straightaways, and then drop down to the inside of the curve on the banked turns. Follow one of the other drivers on the track and study the path he follows. (See *Driving Tips* later in this manual.) Drive slowly at first, and increase your speed as you get more comfortable.

When you first climb into your Indy car, it's configured for a novice driver. Once you're used to handling the car on the track, you can change its configuration to improve its performance if you want. While you don't need to change the car settings to be competitive, there are many adjustments you can make to improve your car. Experiment by slightly changing one setting, and then taking a few laps to feel the effect. (See *Car Configuration* for information on setting up your car.) Change that same setting in the other direction, and take a few more laps to feel how it affected the car's handling. You'll begin to notice which changes give you increased speeds and more precise control, but you'll also need to practice better driving skills to exercise that control.

The key is experimenting with all the settings. Practice driving with different configurations to understand how each adjustment affects your car's handling. And once you understand the dynamics of your car, drive as many laps as needed to get a feel for the track.

Weekend 2: Qualifying Round 1

Qualifying means racing at the absolute limit of your skill and your car's abilities. Your starting position depends entirely on how fast you can drive four laps around the track. This isn't a time for worrying about engine fatigue, fuel efficiency, or tire wear. If you're driving a car with its original setup, reduce the amount of fuel to ten or fifteen gallons to reduce the weight, and set your turboboost on maximum. After you make these two modifications, take a few practice laps to feel their effect.

Because you need to maintain control for only four laps with no other cars on the track, you can configure your car for maximum performance. Don't worry if you can't control the car for long periods — your goal is to put out your best four laps to earn the best possible field position. You can change your car settings before race time comes.

If you drive into the pit during qualifying, your attempt is aborted.

Weekend 3: Qualifying Round 2

Not everyone gets a competitive qualifying time in the first round. The week between the two qualifying sessions is a time many drivers use to fine tune their cars in hopes of squeezing out that extra tenth of a second needed for a good starting position.

Even if you get a respectable qualifying time, you can try again to improve your position. But remember that your last qualifying speed determines your field position, even if your second attempt was slower than your first.

Weekend 4: Race Day

A race can last up to 500 miles, which means driving at speeds upwards of 220 miles per hour for two and a half grueling hours. If you modified your car to qualify, don't expect to control your car for long periods using your qualifying configuration. You need more maneuverability to handle corners and traffic, so you'll need to adjust your car.

Long term racing poses different problems from qualifying. In qualifying, you race all out without worrying about fuel efficiency, tire wear, or engine temperature. In long term racing, you have to sacrifice some speed and maneuverability to address these problems. Another concern that separates the race from qualifying is the strategic element of pit stops. You not only need to drive the best race you can in a carefully-tuned car, you must also plan your race carefully to make it to the finish line. Plan on taking pit stops every 31-34 laps.

THE CARS

If you started from scratch, it would cost a few million dollars to qualify for the Indy 500 with a competitive car. A less expensive way to race at Indy is to race for a team.

Car Requirements

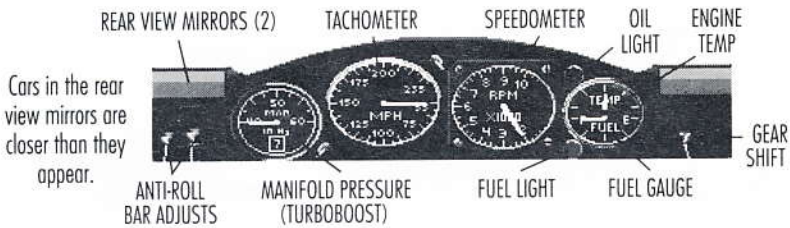
Dimensions (inches)	
Max length	184
Max width	78 1/2
Min wheel base	96
Min tread width	47
Weights (pounds)	
Min car/turbo	1550
Min car/no turbo	1476
Number of seats	1

March Cosworth

This English-built engine started out as a modified Formula One engine. It became popular in the early seventies, and in 1975, 32 of the 33 starters had Cosworth engines. These engines are still fierce competitors today.

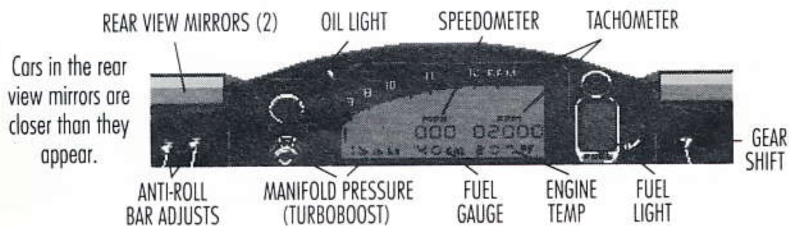
Lola Buick

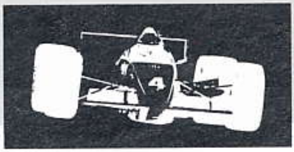
Buick started its Indy program in the mid 1980s. Between the cars' superior horsepower and excellent drivers, Buick captured the first and second field positions in the 1985 race. At first the impressive horsepower wasn't matched with endurance, but Buick has apparently solved many of their problems, as demonstrated by Jim Crawford finishing 6th in the 1988 race.



Penske Chevrolet

In the early 1980s, Roger Penske and others sold Chevrolet on the idea of developing Indy race engines. By 1988 the front row of the Indy 500 consisted of Penske Chevrolets. The car driven by Rick Mears won, breaking Cosworth's decade-long domination of the race.





CAR CONFIGURATION

While your cars have initial settings that make them competitive, you can make chassis adjustments to modify your car's driving characteristics to fit your driving style. To effectively use these settings, it's important to experiment with them and understand the effect each has on your car. Change only one setting at a time, or else you won't know which change was responsible for the car's new driving characteristics.

Make initial settings corresponding to the limits of your driving ability. After making initial settings, fine tune the car on the track. A good sequence to follow when you're tuning your car is as follows:

1. Wings
2. Gears
3. Shocks
4. Stagger
5. Camber
6. Pressures
7. Rubber (tire compound)
8. Anti-Roll Bars

When tuning up your car, only fill your fuel tank halfway. If you set up your car on a full tank, your car's driving characteristics will be different for much of the race, because your rear will be lighter than when you set up your car.

FUEL

Indy cars run on Methanol, an alcohol-based fuel safer than gasoline. It has a higher flash point so it's less likely to ignite if spilled on a hot engine, and if it does ignite it can be extinguished with water. It also burns clean without smoke that would obscure the vision of other drivers after an accident. This display tells you your fuel status:

GAL LEFT	The amount of fuel you have left (gallons).
FILL TO	The amount of fuel you'll fill to at your next pit (gallons).
MILEAGE	Your current fuel mileage (miles per gallon).
PROJ LAPS	How many laps you can go on the fuel you have left, based on your current fuel mileage.

During qualifying, carry only the amount of fuel you need to complete four laps (ten gallons). Every extra gallon of methanol adds $2\frac{1}{4}$ pounds to your car's weight, slowing you up. In a race, however, you want to take as much fuel as necessary to make as few pit stops as possible.

When you have five gallons of fuel or less, your fuel light starts blinking.

Wings

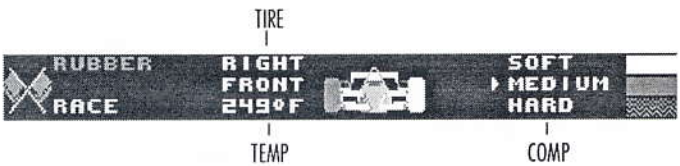
Wings are inverted airfoils designed to push the car onto the track to increase traction. This display shows your wing settings:

FRONT	The downward force your front wing is exerting.
REAR	The downward force your rear wing is exerting.
DRAG	The total drag added to your car by the wings.
BALANCE	The relationship between the front and rear wing settings.

The more downforce exerted by your wings, the more "grip" your tires have, which means you can carry more speed through the turns. But increasing the downforce of your wings, or "adding wing," also increases your drag, which reduces both your maximum speed and your fuel mileage. In general, adding wing makes the car easier to drive, but it also reduces your top speed. As your driving skills improve, you can reduce your downforce to get more speed.

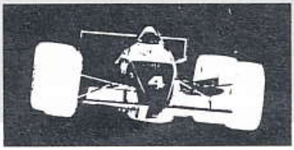
Rubber

Indy tires are thin, tubeless rubber mounted on magnesium wheels. Called "skin tires" or "slicks" because they have no tread, these tires can last up to forty laps. They are composed of different rubber compounds that can either withstand high temperatures for long periods or provide more grip. This display shows the hardness of your tires:



TIRE	Which tire the information represents.
TEMP	The current average temperature of the tire.
COMP	The rubber composition of the tire.

Softer tires grip the track better, improving traction, but they heat up faster, which makes them wear out sooner. Choose tire compounds to optimize grip and endurance. The nature of this relationship is different for each wheel. Since the track only turns left, the stress on the right side tires increases on every turn, especially on the front right tire. More stress means more heat, which means more wear. The more stress a tire is subjected to, the harder it should be.



Each tire compound has maximum traction at a different temperature. Here is a list showing the approximate optimum operating temperature for each tire compound:

Soft	240 degrees (Fahrenheit)
Medium	250 degrees
Hard	260 degrees

If a tire is running at 300 degrees or more, it's too hot. Select a harder compound or set up the car differently to reduce the stress applied to that tire. You can also tell if a tire is overheating by the way it starts to slip on the turns (see "Oversteering and Understeering" in *Tuning Your Car* for details). You can check your tires in the pit to see how worn they are.

STAGGER

Indy cars do not have a differential. (A differential is a gear box in a car that makes the inside tires turn slower than the outside tires during a turn because they don't have to travel as far.) Because the Indianapolis Motor Speedway has only left turns, it's helpful to select right wheels that are larger than the left wheels to make up for the lack of a differential. This is called wheel "stagger." This display shows your wheel stagger:

CAR	Which tires the information represents.
DIAMETER	The diameter of the right tires minus the diameter of the left tires.

If your right wheels have a greater diameter than your left wheels, your car will tend to turn left. While staggering your wheels helps your car on the turns, it will also pull your car to the left on the straights. The degree of wheel stagger you select is a matter of driving skill and style.

QUIZ QUESTION 2. Who was "first in the field" after qualifying for the 1988 race?

Pressures

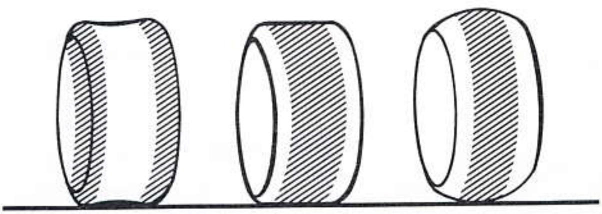
Tire pressure affects how much grip your tires have and how fast they wear out. This display shows your tire pressures:

TIRE

PRESSURE TEMPS

TIRE	Which tire the information represents.
PRESSURE	The current tire pressure.
TEMPS	The current temperatures of the tire: Inner (I), Middle (M), and Outer (O).

You want as much tire touching the ground as possible, because more tire surface area touching the track, called "contact patch," means more grip. Below is a diagram showing the effects of tire pressure on contact patch.



UNDERINFLATED PROPERLY INFLATED OVERINFLATED

These diagrams assume the tire lies flat on the track. If your camber (the angle at which the tires touch the track) is improperly set, you can slightly reduce tire pressure to compensate for the angle and increase your contact patch. This is helpful because camber is a sensitive adjustment that is difficult to set correctly.

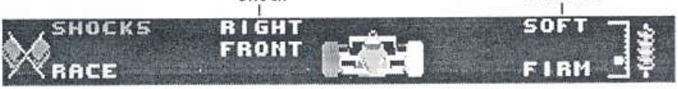
The life of your tire is extended if the temperature is distributed evenly across the tire. An overinflated tire wears and heats up more in the middle, while an underinflated tire wears and heats up more on the edges. Note that tire wear and heating are also affected by camber (see "Camber" in *Car Configuration*).

Other factors increase the heating of your tires as you race; for example, increased downforce and frequent skidding. These factors vary from tire to tire, depending on the other settings on your car, so select tire pressures after you've made your other settings. Since heating increases the pressure in your tires, find initial pressures so the heating of each tire will raise it up to the optimum pressure of 25-30 pounds per square inch (psi).

Shocks

The stiffness of your shock absorbers affects how much time your tires spend touching the track, which affects traction. They are also important in managing load transfer (see "Oversteer and Understeer" in *Tuning Your Car*). This display shows your shock settings:

SHOCK STIFFNESS



SHOCK Which shock absorber the information represents.
STIFFNESS The shock absorber stiffness.

The stiffer your shocks, the quicker your car responds to your steering. But while stiff shocks give you quicker response, the added responsiveness can lead you to overreact. Set the shocks as stiff as you can control. It's a good idea to set the rear shocks slightly softer than the front shocks so you lose less speed in the turns.

Camber

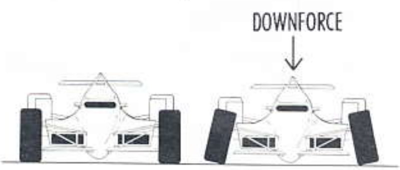
The more surface area of your tire touching the track, the more grip you have (see "Pressures" in *Car Configuration*). Stagger, downforce, and driving conditions can lead your tires to rest on the track unevenly. This display shows your camber settings:

TIRE

CAMBER TEMPS

TIRE Which tire the information represents.
CAMBER The camber setting (slant) of the tire.
TEMPS The current temperatures of the tire: Inner (I), Middle (M), and Outer (O).

The downforce on your car makes the wheels tilt, lifting the outside of the tires off the track. See diagram below:



Adjust the camber of your tires in the pit so the inside of the tires are lifted off the track; then when the downforce on your wings pushes down on your car, the wheels even out and lie perpendicular to the track. You can check if your tires are lying correctly by looking at the temperatures across the tire as you drive. The tire is perpendicular if the inner, middle, and outer temperatures are equal when the tire reaches optimum temperature (assuming it is properly inflated).

Gears

The gear ratios indicate the revolutions per minute (rpms) of your drive wheels divided by the rpms of your engine. This display shows your gear ratios settings:

Nearly all of the race is spent in 4th gear, so it's the most important. A low gear ratio will yield the fastest top speed, but will give the slowest acceleration. If your driving style involves a lot of accelerating out of the curves, you might want a higher gear ratio. A driving style using less acceleration works best with a lower gear ratio. Find the gear ratio that lets you reach your maximum speed just at the end of each long straightaway, and then modify the gear ratio up or down to suit your driving style.

The gear ratio ranges (4th gear) for the three engines are:

Cosworth/Chevrolet	3.8 - 4.9
Buick	2.8 - 3.8

Driving with gear ratios that are too high stresses your engine, possibly leading to engine failure. Using gear ratios that are too low doesn't utilize your engine's maximum horsepower.

Anti-Roll Bars

Indy cars have independent double-wishbone suspension with anti-roll bars to add stability during turns. Adjusting the roll bar firmness has an effect similar to that of setting the wings. Tightening the front anti-roll bar is like adjusting the front wing to exert more downforce, but the anti-roll bar settings are more subtle.

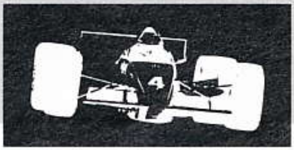
Like shocks, the stiffer your anti-roll bars, the quicker your car responds to your steering. But while stiff anti-roll bars give you better control, the added responsiveness may cause you to overreact. Set the anti-roll bars as stiff as you can control. Set the rear anti-roll bar slightly softer than the front anti-roll bar so you lose less speed in the turns.

Anti-roll bars are also important in managing load transfer (see "Oversteer and Understeer" in *Tuning Your Car*).

Turbocharger

Your car is equipped with a turbocharger. Turboboost increases the air pressure on the intake manifold of your engine; this increases the fuel carried in the mixture, which increases your power. The greater your turboboost, the greater your acceleration. The maximum turboboost pressure for the Cosworth and Buick engines is indicated on the gauge by the red needle.

The drawback to turboboost is that it decreases your fuel efficiency and increases wear and tear on the engine, possibly leading to a failure during longer races. High engine temperature means the engine is running too hard, so you should reduce the turboboost for a while. If the oil light on the dashboard flashes, you need to reduce your boost until your engine temperature comes down. If the light continues to blink, you should use a lower gear ratio.



THE PIT

In pit row, your pit area is marked with a red "X" on the wall and two white painted lines on the asphalt. Stop in between these lines next to the left pit wall and you're in the pit. The Pit Selection board appears; this shows your tire wear and fuel level. You can change tires here or add fuel. (See the *Command Summary Card* for details.)

The main reasons to pull into the pit during a race is to refuel and replace tires. Plan your pit stops based on fuel, and choose the softest tire that will last as long as your fuel supply. This strategy should keep your pit stops to a minimum.

If you want to adjust your car settings during qualifying rounds or a race, you must pull into the pit; during practice you can make these adjustments anywhere and they'll immediately take effect. You can adjust your wing angles, put on different kinds of tires (rubber), put on different diameter tires (stagger), and change your tire pressures. You cannot change your tire camber, shock settings, or gear ratios during a race.

TUNING YOUR CAR

Tuning your Indy car is an art. Nearly every setting affects all the other settings. For example, if you add front wing to improve your tire grip turning corners, these are the effects (ways you can compensate are in parentheses):

- The car tends to oversteer more. (Add rear wing, increase front anti-roll bar tension, increase front shock tension, loosen the rear anti-roll bar, loosen the rear shocks.)
- Drag increases, lowering your speed and acceleration and reducing your fuel mileage. (Increase turboboost, use lower gear ratio.)
- Increases the tire pressure, which can lead to overinflation. An overinflated tire results in less contact patch which causes increased heating and tire wear. A smaller contact patch and an overheated tire lead to less grip. (Lower initial tire pressure.)
- The front tires tilt inward, lifting the outside edges off the track, reducing the tires' contact patch and grip; this increases the tire temperature which makes them wear out faster. (Increase positive camber, decrease tire pressure.)

Whenever you change a setting, try your car out on the track to see how it affects other settings so you can compensate appropriately. Expect to spend a lot of time practicing on the track with different settings.

QUIZ QUESTION 3. Which years were no Indy 500 races held?

Oversteer and Understeer

When you turn at high speeds, the centrifugal force will make your tires lose their grip and you'll slide toward the wall. If the rear tires lose grip first, your rear end slides farther, making your car spin out. This is "oversteer" because your car is turning more than you want it to as your rear tires lose grip. An oversteering car is "loose." The opposite situation occurs when the front tires lose grip first, so your car plows ahead. This is "understeer" because your car isn't turning as much as you want it to. An understeering car is "pushing." A car that's neither pushing nor loose is "neutral."

UNDERSTEER OVERSTEER

Setting the steering capabilities of your car is crucial to driving the fastest possible race. Whether your car oversteers or understeers depends on many different car settings, but the method you use to adjust all these settings depends on a concept known as load transfer.

Load Transfer

When your car's at rest, the right and left tires support equal weight (Indy cars weigh about 1550 pounds). When you turn a corner, some of the weight shifts from the inside tires to the outside tires. This shift results in reduced grip.

Suppose you have a neutral car. If you set the front shocks stiffer than the rear shocks (ignoring all other settings for the moment), more load will transfer between the front wheels than the rear wheels. Load transfer reduces grip, so with these shock settings the front tires will lose more grip than the rear tires lose. This is the definition of understeer — the front tires gripping less than the rear tires during a turn.

The same situation of understeering occurs if you increase the tension of the forward anti-roll bar more than the rear anti-roll bar.

QUIZ QUESTION 4. Who drove the pace car in the 1988 race?

OFFICIAL RACE INFORMATION

Flags

Flags indicate the status of the race. When the flags change, they flash to catch your attention.

Flags	Explanation
Green*	Starts the race and indicates normal racing.
Yellow**	There's been a crash. All cars reduce speed while the wreckage is cleared off the track.
White	The final lap of the race.
Checkered	The end of the race.

* Cyan in CGA
** White and magenta in CGA

Yellow flags usually last from 2-4 laps, but they can last longer if another crash occurs under the yellow flag. Everyone follows the lead car and no one changes field position. If you pull into the pit, you lose your place. Your new position is wherever you reenter the field when you pull out of the pit.

If you're the lead car when a yellow flag appears, and you were about to lap another car, that car can now leave you behind. This is because it can go around the track at a higher speed until it catches up with the pack and occupies the last position.

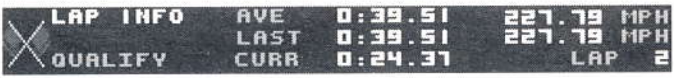
QUIZ QUESTION 5. Who was the oldest driver to win the Indy 500?

Lap Info

You can view lap information at any time. During practice, your display looks like this:

BEST Your best lap time (min:sec.tenths) and your average speed during that lap (miles per hour).
LAST Your last lap time (min:sec.tenths) and your average speed during that lap (miles per hour).
CURR Your current lap time (min:sec.tenths).
LAP Your current lap number.

During qualifying, your display looks like this:



AVG Your average lap time (min:sec.tenths) and your average speed during those laps (miles per hour). This average starts over after four laps.
LAST Your last lap time (min:sec.tenths) and your average speed during that lap (miles per hour).
CURR Your current lap time (min:sec.tenths).
LAP Your current lap number.

During a race, your display looks like this:

LAP Your current lap number and the total laps for the race.
LEAD LAP This tells you that the lead car is racing the same lap as you. If he laps you, this message reads 1 DOWN. If he laps you again, it reads 2 DOWN, etc. This readout only updates when you cross the start/finish line.
LAST Your last lap time (minutes) and your average speed during that lap (miles per hour).
CAR Each time you cross the start/finish line, this display updates to show you how far behind the next car you are. The time shown (min:sec.tenths) tells you how long ago that car crossed the start/finish line. Next to the time is a picture of the car. If the time has a "+" sign in front, you're in the lead by the displayed time.
POS Your current ranking in the race.

After the race is over, the LAST heading changes to RACE. If you were on your last lap, your total time and average speed for the race is shown. If you were more than one lap behind the leader, the word FLAG is shown indicating that you were flagged into the pit because the race ended.

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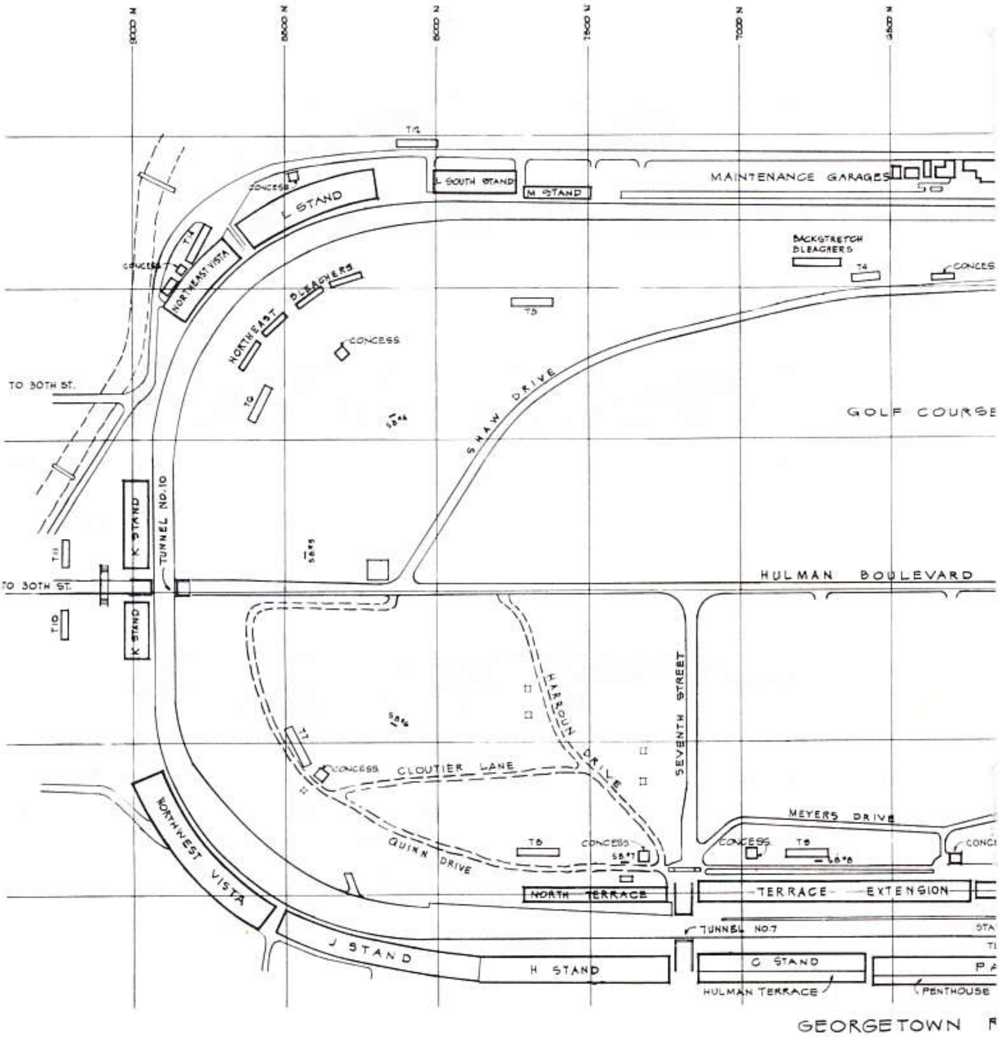

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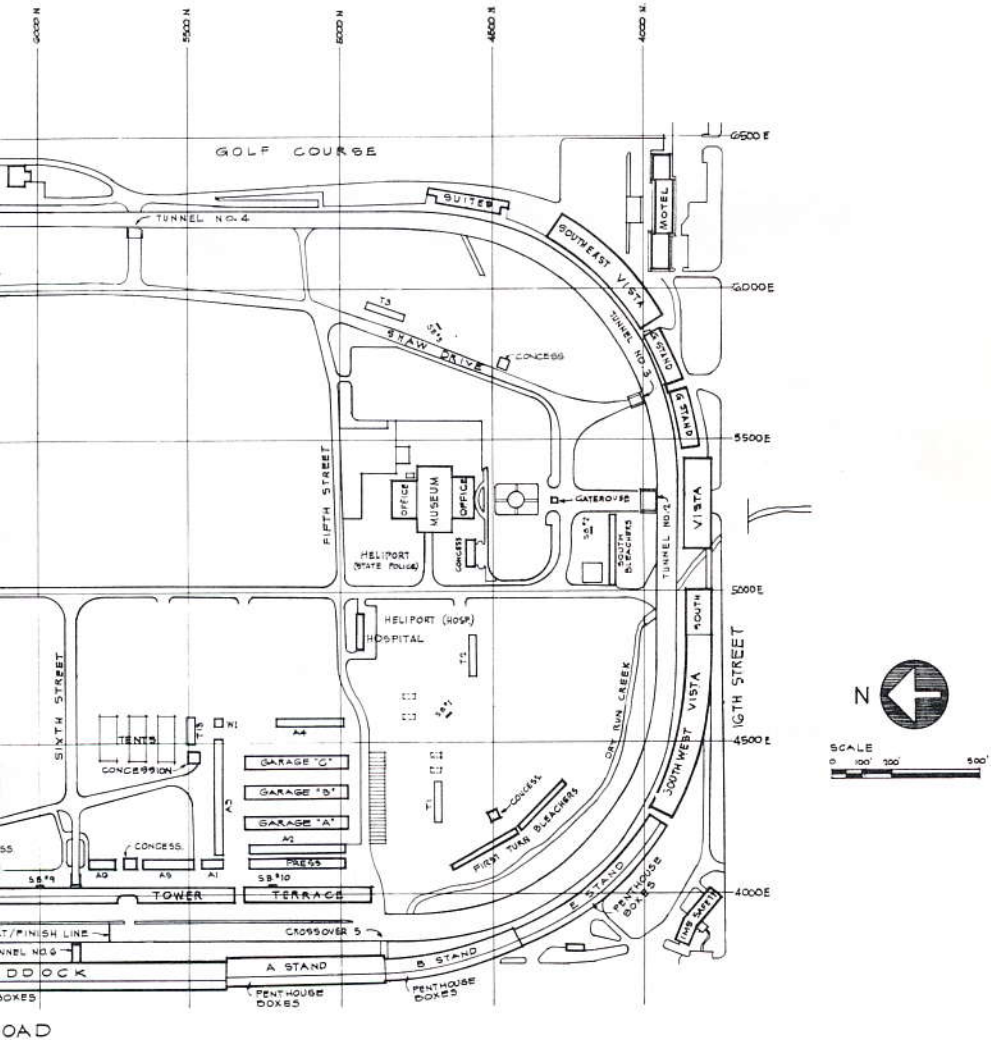
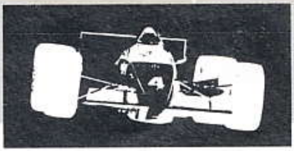
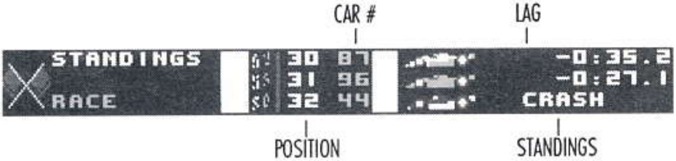




Standings

You can view the standings at any time. (See the *Command Summary Card* for information on viewing standings.) Your standings display is a cross section of the pole and looks like this:



POSITION — Before the race, this shows the qualifying position of each car. During the race, it shows the current position of each car.

CAR # — The car I.D. number.

LAG — This number is how many laps the car is behind the leader. If the car is on the same lap as the leader, this display is blank.

STANDINGS — During the practice and qualifying rounds, this displays each car's qualifying speed. During the race, it shows you how far each car is behind the leading car. The time shown tells you how long that car crossed the start/finish line after the lead car.

If the car is out of the race because of a crash or an equipment failure, the reason appears here; for example, CRASH, GEARBOX, or BEARINGS.

The Standings entry for the lead car shows its average speed throughout the race.

QUIZ QUESTION 6. How much area does the race track cover?

RACE DAY COUNTDOWN

5:00 A.M.	The gates to the Indianapolis Motor Speedway are opened.
8:00 A.M.	The race cars are positioned in front of their respective pits.
9:45 A.M.	The cars are placed in their starting positions.
10:00 A.M.	Featured events, presentations and introductions.
10:35 A.M.	Chief Steward makes final track inspection.
10:42 A.M.	National Anthem.
10:45 A.M.	Invocation
10:46 A.M.	"Taps"; the combined U.S. Armed Forces Color Guard pays homage on this Memorial Day weekend to our war veterans.
10:48 A.M.	The traditional balloons spectacle.
10:51 A.M.	"Gentlemen, start your engines."
10:52 A.M.	The pace car leads the 33 starters for the parade and pace laps.
11:00 A.M.	The Indianapolis 500 begins.

QUIZ QUESTION 7. Who was the first driver to win from the pole position?

INDY RACE CAMS

For the entire month of May, six cameras will be constantly shooting footage as you drive, you can view the last twenty seconds of practice, qualifying, or racing at any time. The six views are:

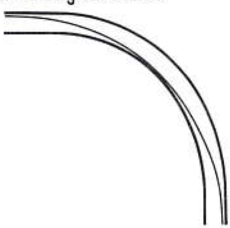
In Car	Your view (as the driver).
Behind	Following behind your car.
Track	From cameras fixed to the track.
TV	From cameras fixed high atop the grandstands.
Sky	From a helicopter following your car.
Leader/Crash	A TV view of the race leader, or a TV view of the last crash if there was one. This camera is not available during practice or qualifying rounds.

DRIVING TIPS

- For beginners: Use cruise control in Practice to fix your car's speed at a comfortable setting, and then concentrate on steering. Slowly increase the speed as you get used to it.

- Be careful entering and leaving the pit. Make sure you slow down substantially so you can avoid other cars and have enough room to stop. Stay in the right lane until you reach your pit area, and then move over to the left. To leave the pit, stay to the left until you've built up some speed, and then move to the right lane when it's clear. Don't come out of pit row too fast or you won't make the turn. Stay below the infield line until you complete the turn so you don't interfere with traffic.

- To lose as little speed as possible on each curve, follow the path for the largest radius turn. Stay near the right wall on the straights. As you near the turn, drop down so your left wheels are just over the white line on the inside of the track. If your car is balanced well, the force of the turn will push you evenly to the outside wall just at the beginning of the next straight. See the diagram below:



OPTIMUM TURNING PATH

- Use instant replays to learn the correct driving path. For example, after turning a corner, watch the sky-view instant replay. This makes it easier to see your mistakes and how to correct them. Also watch the car-view instant replay to find landmarks to help you know when to start your turns.

- Don't let traffic make you forget to follow the correct turning path. It takes skill to pass cars on turns. Novice drivers are tempted to pass cars on the inside as they round the corners, and they forget to follow the optimum path. If you enter the turn too close to the inside curve, the centrifugal force often pushes you out against the car you're trying to pass. And even if you miss the car, you may hit the outside wall because you entered the turn too low.

- If you enter a turn behind another car, it might slow down unpredictably. Ease off the throttle if you are approaching the car too fast. If that isn't enough, tapping the brake quickly will usually slow you down enough to avoid a collision without slowing you down too much.

- Drive cautiously for your first few laps since your tires are cold. Tires don't achieve maximum grip until warmed up.

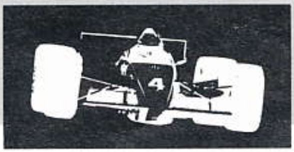
- Under the yellow caution flag, you must drive at speeds slower than your car was set for. Since your wings won't be pushing you down as hard, be prepared for different steering responses. Don't expect to be able to turn as sharply as you can at higher speeds.

- When you're used to the car and have it set for high speeds, you'll notice that as you race your car's handling changes. This is mainly due to two effects. First, as you use fuel the tank over the rear wheels gets lighter. Second, your tires are wearing out. Slightly adjust the rear anti-roll bars periodically as you drive to compensate for these factors.

- Your front left tire experiences the least stress, so a soft tire compound can last up to 100 laps. Don't change this tire at every pit stop; check to see that it's worn out first.

- At your last pit stop during a race, fill your tank with just enough fuel to finish the race. A full tank will excessively weigh you down.

QUIZ QUESTION 8. Who was the last rookie to win at Indy?



THE WINNER'S CIRCLE

Being the first to drive under the checkered flag has many rewards. First the winner's car is pushed up the ramp to the Winner's Circle. Then the driver is awarded a wreath, the Borg-Warner trophy, and a much needed bottle of milk.

The Borg-Warner trophy has been presented to the winner of the Indianapolis 500 since 1936. Made of sterling silver, it's over four feet tall and weighs 80 pounds. A bas-relief bust of every winner since 1911 is on this trophy which is insured at $150,000.

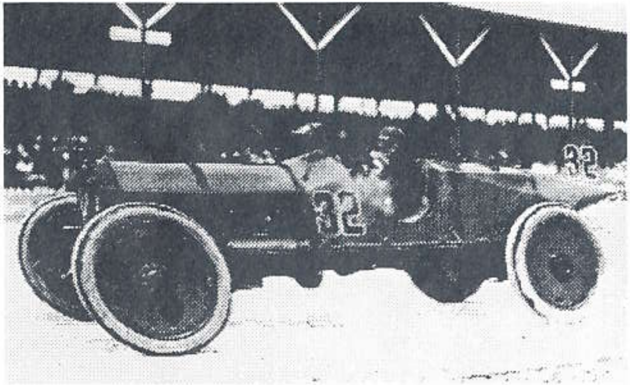
The winner receives the largest percentage of a multi-million dollar purse, amounting to several hundred thousand dollars. He or she can also count on interviews and product-endorsement requests for many years to come. And finally, every Indy winner earns a permanent place in the history books.

BLAST FROM THE PAST

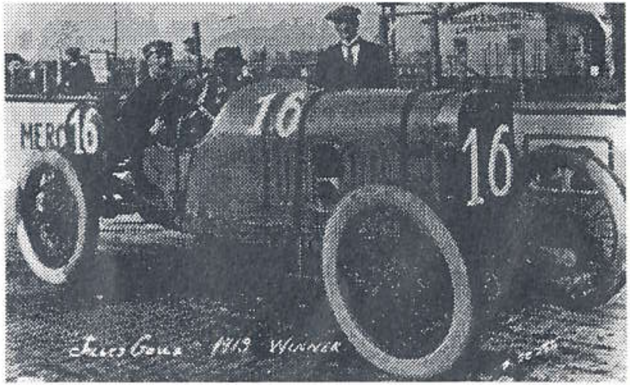
Since 1911, when Ray Harroun roared across the finish line after nearly seven hours of racing at an average speed of 74.59 miles per hour, the world's best drivers have come to Indianapolis each spring to pit their skills and machines against the best of the best.

Here are pictures of past Indy winners, from Ray Harroun in 1911 to Emerson Fittipaldi in 1989, along with their average speed and winning time.

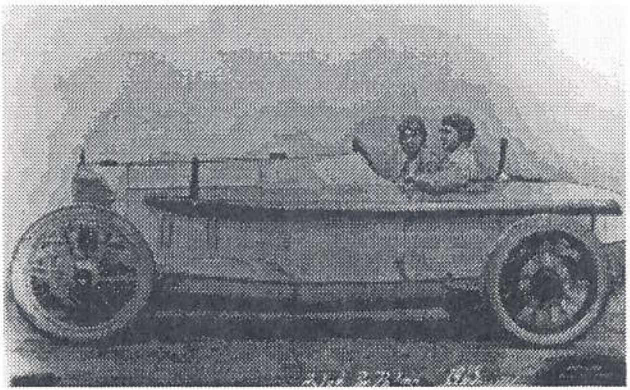
QUIZ QUESTION 9. Who was the first driver to win two consecutive races?



1911 Ray Harroun
74.59 MPH Time = 6:42:08

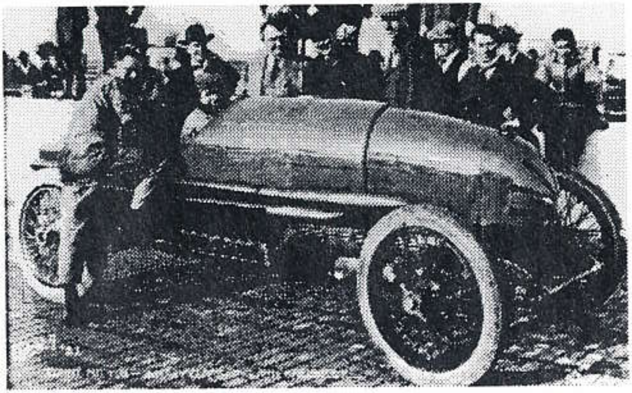


1913 Jules Goux
75.93 MPH Time = 6:35:05

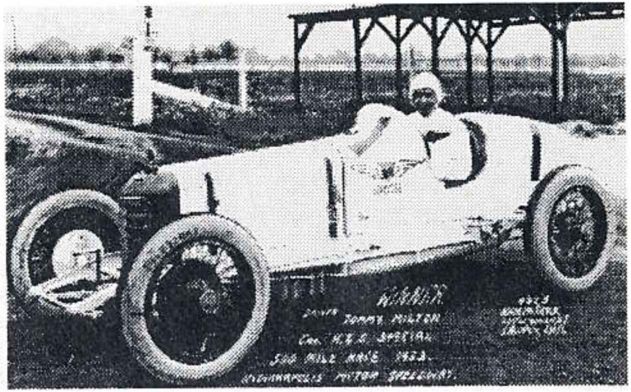


1915 Ralph DePalma
89.84 MPH Time = 5:33:55

1919 Howdy Wilcox
88.05 MPH Time = 5:40:42

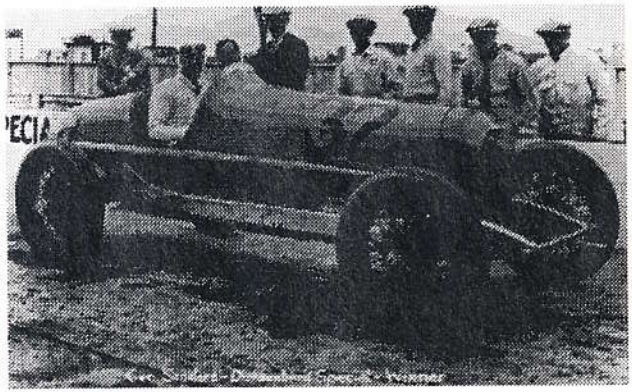


1921 Tommy Milton
89.62 MPH   Time = 5:34:44

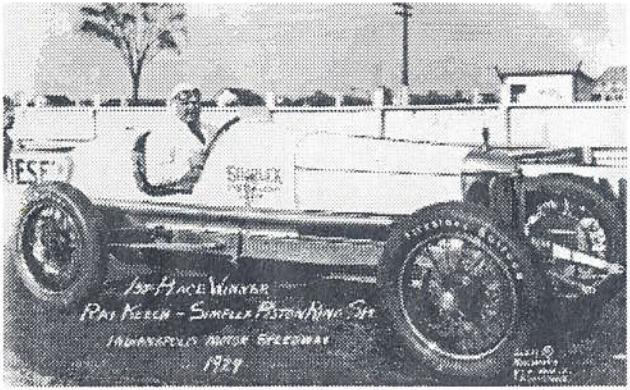


1923 Tommy Milton
90.95 MPH   Time = 5:29:50

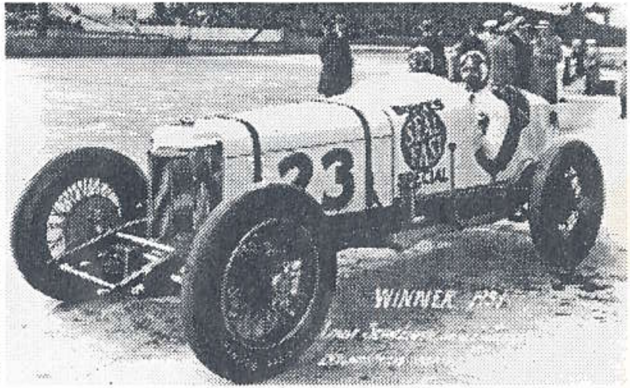
1925 Peter DePaolo
101.13 MPH   Time = 4:56:39



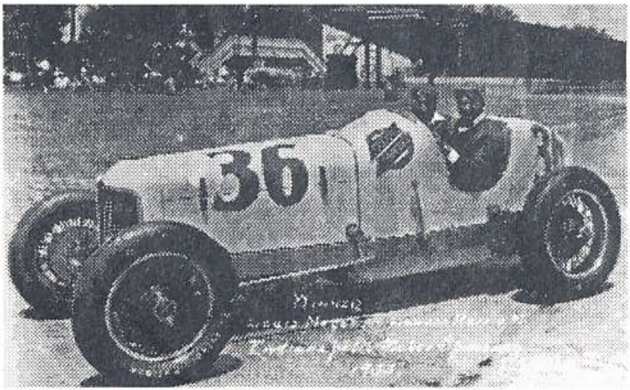
1927 George Souders
97.545 MPH   Time = 5:07:33



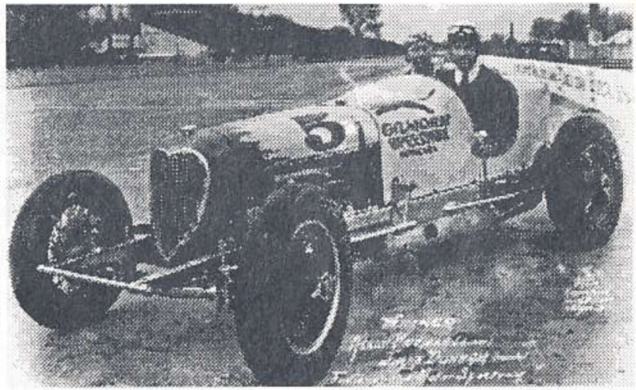
1929 Ray Keech
97.585 MPH   Time = 5:07:25



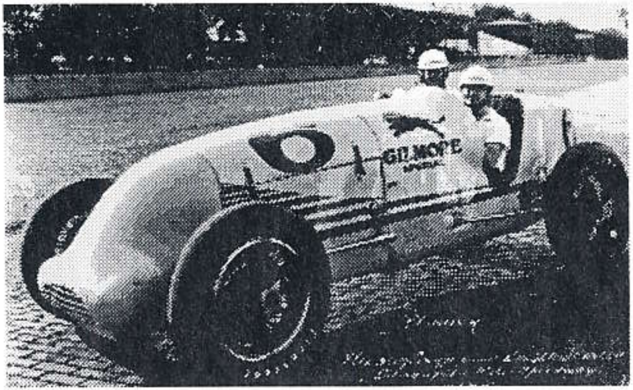
1931 Louis Schneider
96.629 MPH   Time = 5:10:27



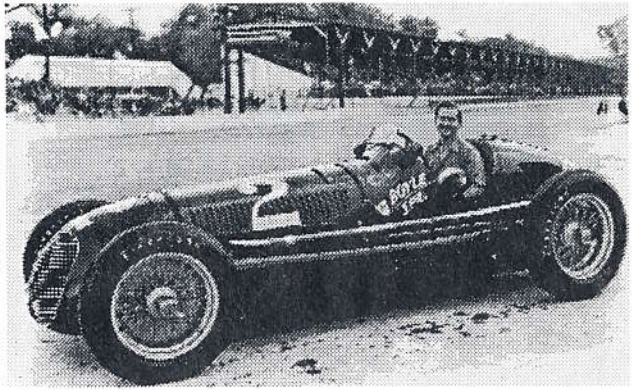
1933 Louis Meyer
104.162 MPH   Time = 4:48:00



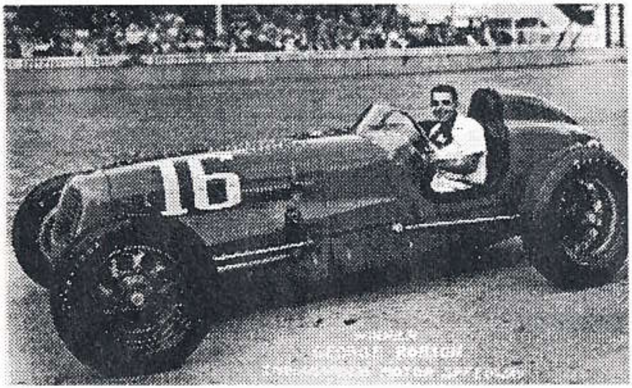
1935 Kelly Petillo
106.240 MPH   Time = 4:42:22



1937 Wilbur Shaw
113.580 MPH   Time = 4:24:07



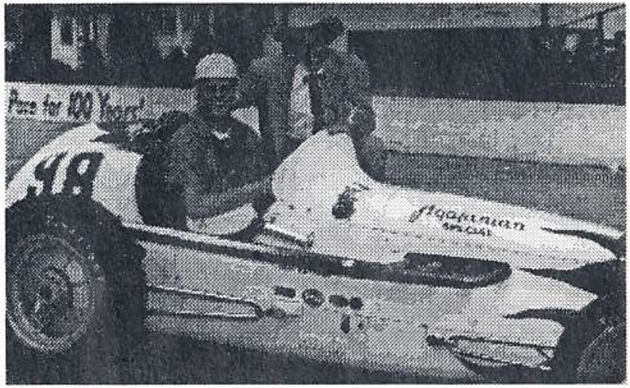
1939 Wilbur Shaw
115.035 MPH   Time = 4:20:47



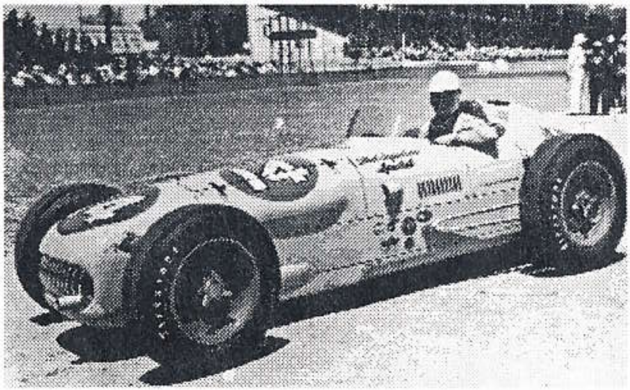
1946 George Robson
114.820 MPH   Time = 4:21:16

1948 Mauri Rose
119.814 MPH   Time = 4:10:23

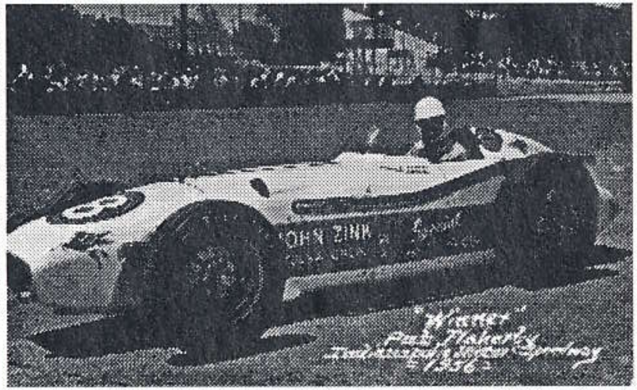
1950 Johnnie Parsons
124.002 MPH Time = 2:46:55



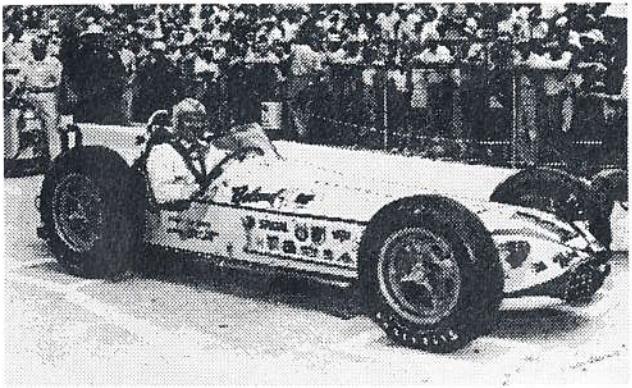
1952 Troy Ruttman
128.922 MPH Time = 3:52:41



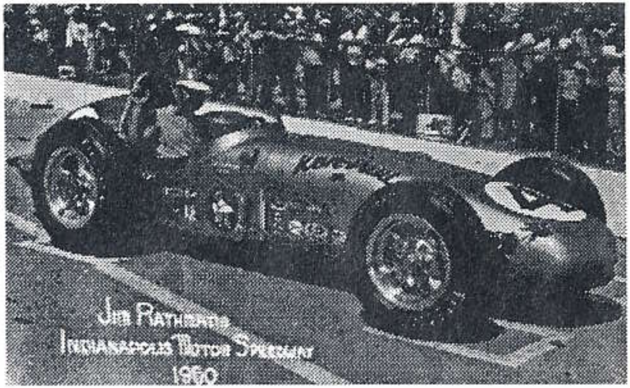
1954 Bill Vukovich
130.840 MPH Time = 3:49:17



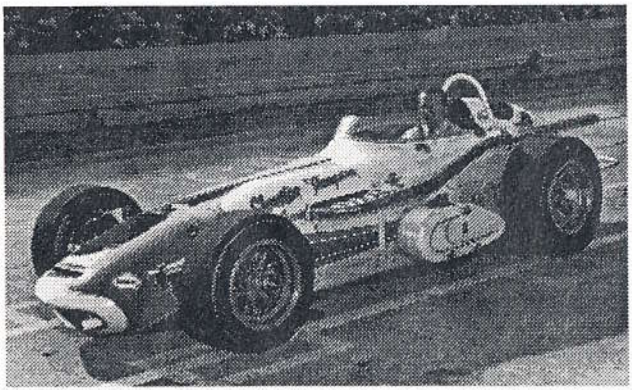
1956 Pat Flaherty
128.490 MPH Time = 3:53:28



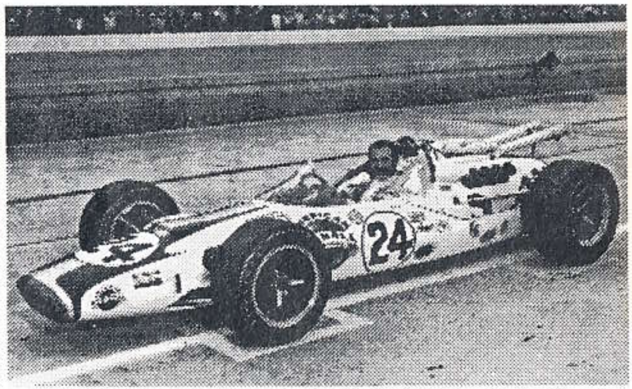
1958 Jimmy Bryan
133.791 MPH   Time = 3:44:13



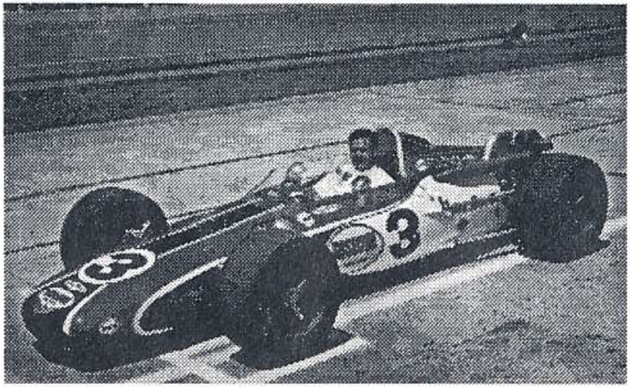
1960 Jim Rathmann
138.767 MPH   Time = 3:36:11



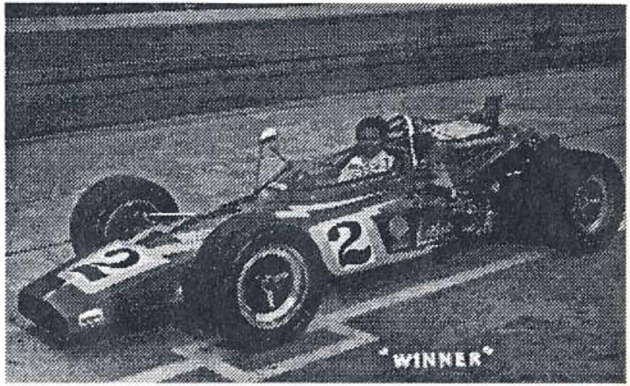
1964 A. J. Foyt Jr.
147.350 MPH   Time = 3:23:35



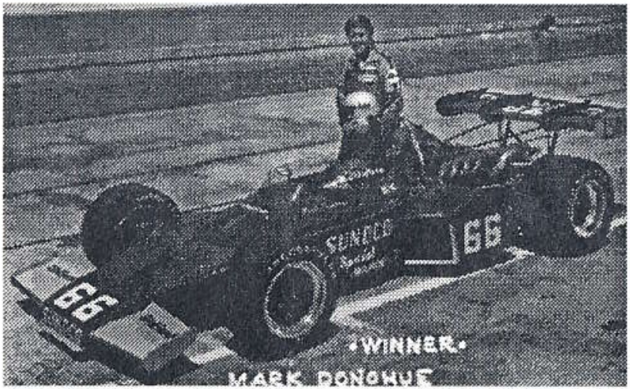
1966 Graham Hill
144.317 MPH   Time = 3:27:52



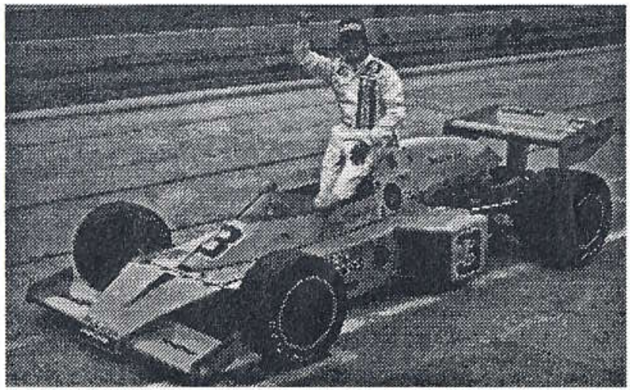
1968 Bobby Unser
152.882 MPH   Time = 3:16:13



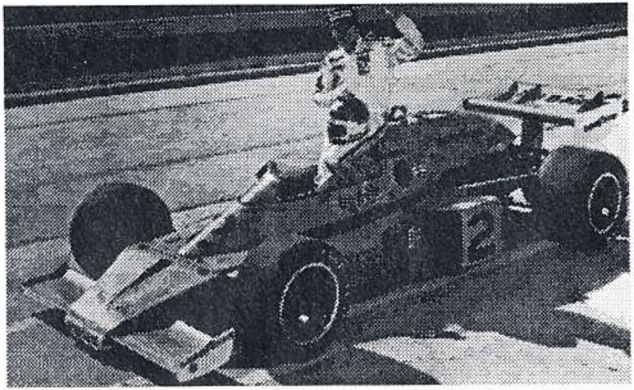
1970 Al Unser
155.749 MPH   Time = 3:12:37



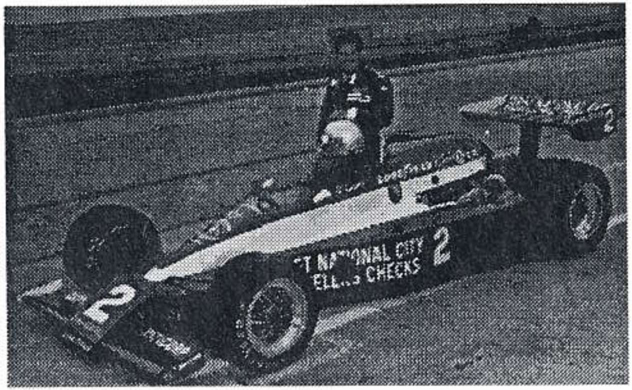
1972 Mark Donohue
162.962 MPH   Time = 3:04:05



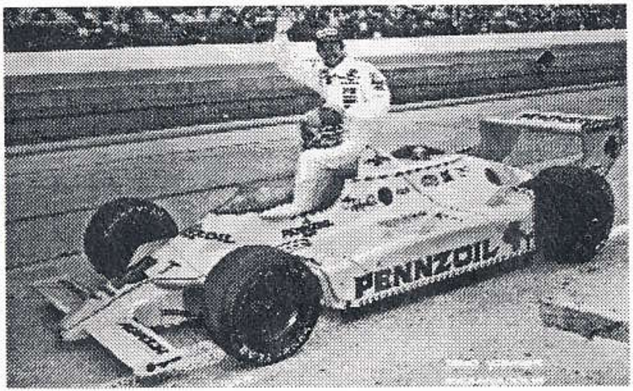
1974 Johnny Rutherford
158.589 MPH   Time = 3:09:10



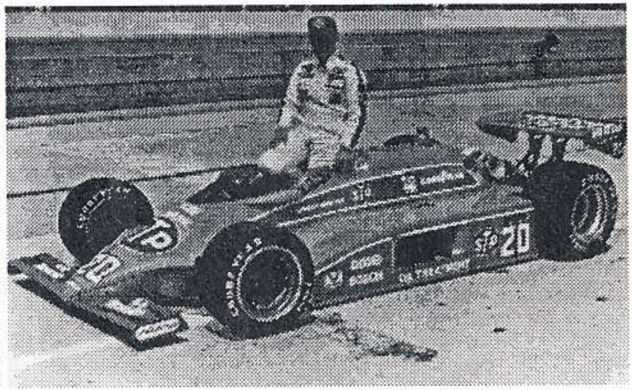
1976 Johnny Rutherford
148.725 MPH   Time = 1:42:52



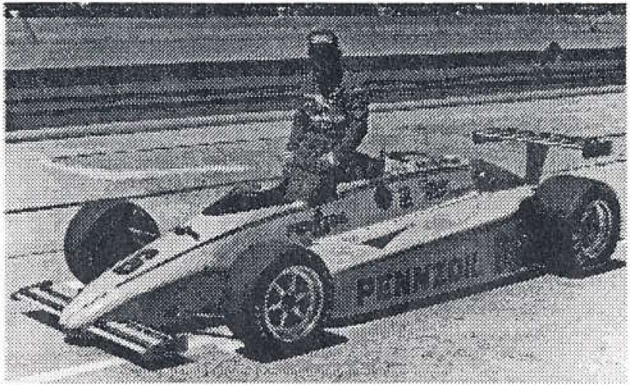
1978 Al Unser
161.363 MPH   Time = 3:05:54



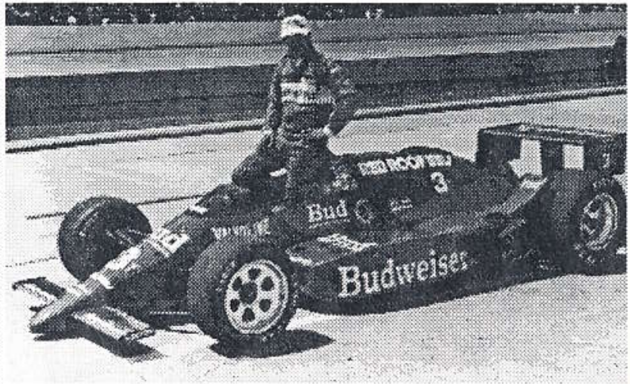
1980 Johnny Rutherford
142.862 MPH   Time = 3:29:59.56



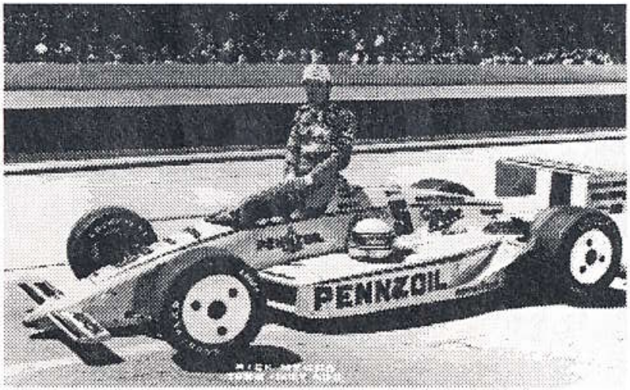
1982 Gordon Johncock
162.029 MPH   Time = 3:05:09.14



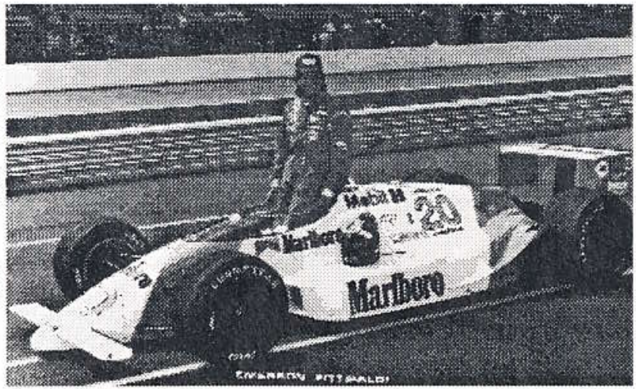
1984 Rick Mears
163.612 MPH Time = 3:03:21.660



1986 Bobby Rahal
170.722 MPH Time = 2:55:43.480



1988 Rick Mears
144.809 MPH Time = 3:27:10.204



1989 Emerson Fittipaldi
167.581 MPH Time = 2:59:01.049

QUIZ ANSWERS

1. Bill Vukovich III
2. Mario Andretti
3. 1917-1918 for WWI, and 1942-1945 for WWII
4. General Chuck Yeager
5. Al Unser in 1987 — 47 years, 11 months old
6. 433 acres
7. Jimmy Murphy, 1922
8. Graham Hill, 1966
9. Wilbur Shaw, 1939 & 1940

NOTICE

MANUAL BY ERIC LINDSTROM
EDITED BY Z.J. YEE

Indianapolis Motor Speedway Map courtesy of the Indianapolis Motor Speedway Corporation.

Front Cover Photo: IMS photos by Ron McQueeney/Ed Kackley and Denis Sparks. Flag photo by Bob Tronolone.

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Historic Car Photos: 1972 - 1989 Courtesy Ron McQueeny.

Special thanks to Connie Braat for diagrams and illustrations.

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